Ephemeris for Physical Observations of the Moon, 1897 September to 1898 April.   By A. Marth.

Greenwich Noon.	Selenographical Colong. of the Sun.	Lat. of the Sun.	Geocentric Libration Sel. Long. of the Earth.	Lat. of the Earth.	Combined Amount.	Direction.
1897.	°	°	°	°	°	°
Sept. 4	4·80	−0·93	+2·45	+4·84	5·42	333·2
5	17·00	0·95	3·29	3·56	4·85	317·3
6	29·19	0·98	3·98	2·09	4·49	297·8
7	41·38	1·00	4·49	+0·51	4·52	276·5
8	53·56	1·02	4·82	−1·07	4·94	257·5
9	65·74	1·05	4·98	2·57	5·60	242·7
10	77·91	1·07	+4·95	3·91	6·30	231·6
11	90·08	1·09	4·71	5·02	6·88	223·1
12	102·25	1·11	4·26	5·86	7·24	215·9
13	114·42	−1·13	3·59	6·40	7·33	209·2
14	126·60	1·15	2·71	6·63	7·16	202·1
15	138·78	1·17	1·65	6·56	6·77	194·1
16	150·97	1·19	+0·45	−6·21	6·23	184·1
17	163·16	1·20	−0·85	5·59	5·66	171·4
18	175·35	1·22	2·16	4·73	5·20	155·5
19	187·55	1·23	3·42	3·66	5·01	137·0
20	199·75	1·25	4·53	2·42	5·13	118·1
21	211·96	1·26	5·41	−1·03	5·50	100·9
22	224·17	−1·27	−5·97	+0·43	5·98	85·9
Oct. 2	346·36	−1·39	+4·36	+3·63	5·67	309·9
3	358·55	1·41	5·12	2·20	5·57	293·3
4	10·74	1·42	5·60	+0·66	5·63	276·7
5	22·92	1·43	5·81	−0·89	5·88	261·3
6	35·09	1·44	5·81	2·36	6·26	247·9
7	47·26	1·46	+5·60	−3·68	6·74	236·6
8	59·42	1·47	5·23	4·79	7·09	227·4
9	71·58	1·48	4·70	5·65	7·34	219·6
10	83·74	1·49	4·01	6·22	7·40	212·6
11	95·90	−1·49	3·16	6·50	7·22	205·8
12	108·05	1·50	2·15	6·48	6·83	198·3
13	120·21	1·51	+1·01	−6·17	6·25	189·2
14	132·37	1·51	−0·26	5·59	5·59	177·4
15	144·54	1·52	1·60	4·77	5·03	161·5
16	156·71	1·52	2·96	3·75	4·78	141·8

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Greenwich Noon.	Selenographical Colong. of the Sun.	Lat.	Geocentric Libration Sel. Long. of the Earth.	Lat.	Combined Amount.	Direction.
1897.						
Oct. 17	168·88	1·52	4·27	2·57	4·91	121·0
18	181·06	1·52	5·44	−1·24	5·58	102·8
19	193·24	1·52	6·38	+0·17	6·38	88·5
20	205·43	−1·52	−6·99	+1·60	7·17	77·1
Nov. 1	351·85	−1·51	+6·90	−1·41	7·05	258·5
2	4·02	1·51	7·04	2·84	7·59	248·0
3	16·19	1·51	6·87	4·09	7·99	239·1
4	28·35	1·51	6·45	5·12	8·23	231·4
5	40·50	1·50	5·84	5·87	8·29	224·7
6	52·65	1·49	5·05	6·34	8·10	218·4
7	64·80	1·49	4·13	6·52	7·72	212·2
8	76·94	1·48	3·09	6·41	7·11	205·6
9	89·08	1·47	1·95	6·20	6·49	197·4
10	101·22	−1·46	+0·70	5·64	5·68	187·1
11	113·37	1·45	−0·61	4·83	5·87	172·8
12	125·51	1·44	1·98	3·82	4·30	152·7
13	137·66	1·43	3·34	2·64	4·26	128·3
14	149·81	1·42	4·68	−1·33	4·86	105·9
15	161·96	1·40	5·84	+0·05	5·84	89·5
16	174·12	1·39	6·82	1·45	6·97	77·9
17	186·29	1·37	7·49	2·82	8·00	69·3
18	198·46	1·36	7·80	4·09	8·80	62·2
19	201·64	−1·34	−7·61	+5·18	9·20	55·6
Nov. 29	332·56	−1·21	+7·42	−2·18	7·73	253·6
30	344·73	1·19	7·66	3·59	8·45	244·8
Dec. 1	356·89	1·18	7·52	4·76	8·89	237·5
2	9·05	1·16	7·06	5·67	9·05	231·1
3	21·20	1·14	6·34	6·29	8·92	225·0
4	33·35	−1·12	+5·41	−6·61	8·53	219·1
5	45·49	1·10	4·33	6·63	7·92	213·0
6	57·63	1·08	3·15	6·36	7·09	206·2
7	69·77	1·06	1·88	5·81	6·11	197·9
8	81·90	1·04	+0·57	−5·02	5·05	186·5
9	94·03	−1·01	−0·77	4·00	4·08	169·2
10	106·16	0·99	2·10	2·81	3·51	143·3
11	118·29	0·96	3·39	1·49	3·71	113·8
12	130·43	0·94	4·61	−0·10	4·61	91·2

| Greenwich Noon. | Selenographical | | Geocentric Libration | | | Direc-tion. |
	Colong. of the Sun.	Lat.	Sel. Long. of the Earth.	Lat.	Combined Amount.	
1897. Dec. 13	142·57	−0·91	−5·69	+1·32	5·85	76·9
14	154·71	0·89	6·59	2·71	7·12	67.6
15	166·86	0·86	7·22	3·99	8·25	61·0
16	179·01	0·83	7·53	5·10	9·09	55·8
17	191·17	−0·81	−7·45	+5·98	9·54	51·1
Dec. 28	325·19	−0·56	+7·34	−4·68	8·70	237·3
29	337·36	0·53	7·36	5·61	9·24	232·5
30	349·52	0·51	6·99	6·31	9·41	227·7
31	1·68	0·48	6·30	6·70	9·19	223·0
1898. Jan. 1	13·83	−0·45	+5·36	−6·78	8·63	218·1
2	25·98	0·43	4·22	6·56	7·80	212·6
3	38·12	0·40	2·96	6·05	6·74	206·0
4	50·26	0·37	1·63	5·29	5·54	197·1
5	62·39	0·34	+0·29	4·30	4·33	186·0
6	74·52	0·31	−1·03	3·13	3·29	161·7
7*	86·65	0·27	2·29	1·80	2·91	128·3
8	98·78	−0·24	3·44	−0·39	3·46	96·4
9	110·91	0·21	4·45	+1·06	4·58	76·6
10	123·04	0·18	5·28	2·48	5·83	64·8
11	135·18	0·15	5·95	3·80	7·06	57·3
12	147·32	0·12	6·36	4·96	8·06	51·9
13	159·46	0·08	−6·51	5·89	8·77	47·7
14	171·61	0·05	6·36	6·52	9·10	44·1
15	183·77	−0·03	5·90	+6·81	9·00	40·7
16	195·93	0·00	5·13	6·70	8·43	37·2
17	208·10	+0·03	4·05	6·19	7·39	33·0
18	220·28	0·06	2·71	5·28	5·94	27·0
19	232·46	0·08	−1·17	4·02	4·18	16·2
20	244·65	0·10	+0·46	2·47	2·51	349·5
21†	256·84	0·13	2·08	+0·76	2·21	290·0
22	269·03	0·15	3·56	−0·99	3·70	254·4

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 * During the small partial eclipse of the Moon on 1898 January 7. which, according to the *Nautical Almanac* for 1899, p. xiii. begins at $11^h 47^m·4$ and ends at $13^h 22^m·4$, the shadow does not seem to pass over any spot of well determined selenographical position.

 † During the eclipse of January 21 the selenographical longitude Λ and latitude B of the point on the lunar surface in the centre of the shadow-cone

Greenwich Noon.	Selenographical		Geocentric Libration.			
	Colong.	Lat.	Sel. Long.	Lat.	Combined	Direc-
	of the Sun.		of the Earth.		Amount.	tion.
1898.						
Jan. 23	281·23	0·18	4·81	2·65	5·49	241·1
24	293·42	0·20	5·74	4·10	7·05	234·3
25	305·61	0·23	6·29	5·28	8·20	229·9
26	317·79	+0·25	+ 6·44	−6·12	8·88	226·3
27	329·97	0·28	6·20	6·63	9·07	222·9
28	342·14	0·31	5·61	6·80	8·81	219·3
29	354·31	0·33	4·71	6·61	8·15	215·1
30	6·47	0·36	3·59	6·22	7·18	209·9
31	18·62	0·39	2·32	5·52	5·99	202·7
Feb. 1	30·77	+0·42	+0·97	−4·59	4·69	191·9
2	42·92	0·45	−0·39	3·46	3·49	173·6
3	55·06	0·48	1·67	2·18	2·75	142·5
4	67·20	0·51	2·83	−0·78	2·94	105·5
5	79·34	0·54	3·82	+0·67	3·87	80·1
6	91·47	0·57	4·58	2·11	5·04	65·3
7	103·60	+0·60	5·11	3·47	6·18	55·7
8	115·74	0·63	−5·38	4·68	7·13	48·9
9	127·88	0·66	5·41	5·67	7·83	43·5
10	140·02	0·69	5·20	6·36	8·21	39·1
11	152·17	0·72	4·78	6·72	8·23	35·3

and the position angle P of the Moon's axis, reckoned as usually from the declination circle, will be

1898 Jan. 21	16 Gr. $\Lambda = + 5·03$	$B = -0·12$	$P = 348·45$
	18	4·02	0·12	·48
	20	3·00	0·13	·50
	22	+2·98	−0·13	348·53

The selenographical longitude λ and latitude β of the point on the rim of the Moon's disc in position angle p are found by

$$\sec s' \cos \beta \sin (\Lambda - \lambda) = \sin (p - P)$$
$$\sec s' \cos \beta \cos (\Lambda - \lambda) = -\cos (p - P) \sin B + \tan s' \cos B$$
$$\sec s' \sin \beta \qquad\qquad = \cos (p - P) \cos B + \tan s' \sin B,$$

where s' is the apparent semidiameter of the Moon's disc, or, if it is not worth while taking s' and B into account, if

$p - P$ is between 0° and 180°, by $\lambda = \Lambda - 90°$ and $\beta = 90° - (p - P)$

and if

$p - P$ is between 180° and 0°, by $\lambda = \Lambda + 90°$ and $\beta = 90° + p - P$.

The position-angle of the axis of the Sun will be 351°·78 and the heliographical latitude of the centre of the disc—5°·39.

Greenwich Noon.	Selenographical Colong. of the Sun.	Lat.	Sel. Long. of the Earth.	Geocentric Libration. Lat.	Combined Amount.	Direction.
1898.						
Feb. 12	164·32	0·74	4·16	6·69	7·87	31·8
13	176·48	0·76	3·38	6·28	7·12	28·2
14	188·65	+ 0·78	− 2·46	+ 5·48	6·00	24·1
Feb. 24	310·59	+ 0·98	+ 5·06	− 6·67	8·36	217·0
25	322·78	1·01	4·51	6·62	8·00	214·1
26	334·97	1·03	3·65	6·26	7·24	210·1
27	347·15	1·05	2·55	5·63	6·18	204·3
28	359·33	+ 1·07	+ 1·28	− 4·76	4·93	195·0
Mar. 1	11·50	1·09	− 0·08	3·70	3·70	178·7
2	23·66	1·11	1·44	2·47	2·86	149·8
3	35·82	1·14	2·72	− 1·13	2·94	112·5
4	47·98	+ 1·16	− 3·81	+ 0·28	3·82	85·7
5	60·13	1·18	4·66	1·71	4·96	69·9
6	72·28	1·20	5·21	3·08	6·05	59·4
7	84·43	1·22	5·44	4·32	6·94	51·4
8	96·57	1·24	5·33	5·36	7·55	44·7
9	108·72	+ 1·26	− 4·91	+ 6·12	7·84	32·6
10	120·87	1·27	4·24	6·54	7·79	32·8
11	133·02	1·29	3·37	6·58	7·39	27·0
12	145·18	1·30	2·40	6·22	6·67	21·1
13	157·34	1·32	1·40	5·48	5·65	14·3
14	169·51	+ 1·33	− 0·40	+ 4·40	4·42	5·2
Mar. 24	291·55	+ 1·42	+ 4·11	− 6·53	7·71	212·1
25	303·76	1·43	3·47	6·23	7·13	209·0
26	315·97	1·44	2·57	5·66	6·21	204·3
27	328·18	1·45	1·44	4·83	5·04	196·5
28	340·38	1·46	+ 0·15	3·81	3·81	182·2
29	352·57	+ 1·47	− 1·23	2·63	2·90	154·9
30	4·76	1·48	2·61	− 1·33	2·93	117·1
31	16·95	1·49	3·89	+ 0·04	3·88	89·5
Apr. 1	29·13	1·50	4·97	1·42	5·17	74·0
2	41·30	1·50	5·77	2·77	6·40	64·3
3	53·47	+ 1·51	− 6·22	+ 4·02	7·40	57·1
4	65·64	1·52	6·25	5·09	8·06	50·7
5	77·80	1·52	5·87	5·91	8·32	44·7
6	89·96	1·53	5·09	6·41	8·17	38·3
7	102·12	1·53	3·99	6·52	7·64	31·3

Greenwich Noon.	Selenographical		Geocentric Libration.			Direc-
	Colong.	Lat.	Sel. Long.	Lat.	Combined	tion.
	of the Sun.		of the Earth.		Amount.	
1898.	°	°	°	°	°	°
Apr. 8	114·28	+ 1·53	2·67	+ 6·22	6·77	23·1
9	126·45	1·53	− 1·26	5·52	5·66	12·8
10	138·62	1·53	+ 0·12	4·46	4·47	358·4
11	150·80	1·53	1·39	3·12	3·42	336·1
12	162·98	1·53	2·47	+ 1·60	2·94	302·9
13	175·17	1·52	3·35	− 0·00	3·35	269·9
14	187·37	1·52	4·03	1·58	4·33	248·5
15	199·58	+ 1·51	+ 4·51	− 3·05	5·44	235·9

The selenographical positions of the Sun at the times assigned to the five published plates of the Lick Observatory Atlas of the Moon are the following ;—

Selenographical		Assigned			
Colong.	Lat.	Pacific Standard Times.			
of the Sun.					
°	°		h m s s		
184·77	− 0·93	1895 Oct. 10	16 49 10–17	Plate 1
172·64	− 0·91	1895 Oct. 9	16 55 30–40	,, 2
159·56	− 0·89	1895 Oct. 8	15 9 10–20	,, 3
172·62	− 0·91	1895 Oct. 9	16 53 2–12	,, 4
61·07	− 1·40	1896 Oct. 18	10 32 41–47	,, 5

The data for ascertaining the times when, for a number of spots represented on the photographs, the Sun reaches the zenith distances corresponding to those at the assigned times, are given in the following list, the data for plate 1 being already included in the list on page 90, under " Lick 6."

Sun's Colongitude.		Spot.	Pl.	Sun's Colongitude.		Spot.	Pl.
°	⊙'s.			°	⊙'s.		
58·68 − 1·696	lat.	Horrebow	5	158·48 − 1·214	,,	Cuvier	3
59·06 − 1·421	,,	Bouguer	5	158·58 − 1·111	,,	Tycho	3
59·34 − 1·220	,,	Bianchini	5	158·59 − 1·093	,,	Clairaut	3
59·47 − 1·136	,,	Sharp	5	158·71 − 0·954	,,	Maurolycus	3
59·70 − 0·969	,,	C. Heraclides	5	158·93 − 0·706	,,	Gemma Frisius	3
59·73 − 0·953	,,	Harpalus	5	159·02 − 0·609	,,	Aliacensis	3
59·87 − 0·849	,,	Mairan	5	159·10 − 0·522	,,	Apianus	3
60·16 − 0·639	,,	Delisle	5	159·17 − 0·441	,,	Sacrobosco	3
60·22 − 0·600	,,	Wollaston	5	159·26 − 0·342	,,	Geber	3
60·36 − 0·498	,,	Euler	5	159·34 − 0·244	,,	Abulfeda	3
60·38 − 0·480	,,	Pytheas	5	159·38 − 0·210	,,	Albategnius	3
60·45 − 0·442	,,	Aristarchus	5	159·68 − 0·990	,,	Stöfler	3

Sun's Colongitude.		Spot.	Pl.	Sun's Colongitude.		Spot.	Pl.
	⊙'s.				⊙'s.		
167·73	−5·50 lat.	Newton	2	172·05	−0·650 ,,	Hell	2
170·08	−2·837 ,,	Moretus	2	172·09	−0·608 ,,	Pitatus	2
170·58	−2·287 ,,	Blancanus	2	172·17	−0·494 ,,	Purbach	4
170·72	−2·135 ,,	Scheiner	2	172·26	−0·401 ,,	Thebit	4
171·11	−1·698 ,,	Clavius	2	172·36	−0·292 ,,	Alpetragius	4
171·11	−0·586 ,,	Aliacensis	2	172·41	−0·235 ,,	Alphonsus	4
171·23	−1·570 ,,	Longomontanus	2	172·44	−0·201 ,,	Albategnius	4
171·37	−1·394 ,,	Lilius	2	172·48	−0·158 ,,	Ptolemaeus	4
171·52	−1·235 ,,	Maginus	2	172·49	−0·143 ,,	Hipparchus	4
171·75	−0·989 ,,	Tycho	2	172·57	−0·057 ,,	Mösting A.	4
171·77	−0·957 ,,	Stöfler	2	172·69	+0·072 ,,	Triesnecker A.	4
171·96	−0·754 ,,	Cichus	2	172·73	+0·118 ,,	Bode	4

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